Generating and programming lipid artificial organelles

Spatial organization is a defining feature in cells. Many biological processes take place in membrane-bound organelles, where molecules can be concentrated and co-localized to favor specific biological processes while preventing undesired reactions. Although the majority of studies have tended to employ lipid vesicles as experimental model systems to emulate subcellular organelles organization, few organelles possess these spherical, lamellar structures. Organelles instead often adopt a wide variety of shapes and sizes that enable to carry out specialized functions. Therefore, the formation of non lamellar synthetic models capable of mimicry cellular organelle functions is a major goal in synthetic cell research.

We are approaching this challenge by developing synthetic lipids that spontaneously self-assemble into non lamellar phases. Such structures can be enriched with simple precursors of bioconjugation reactions, rendering the assembly capable of confining biological molecules and pathways with high efficiency and in a programmable manner. We envision that using robust bioconjugation methodologies to generate and program non lamellar lipid assemblies will facilitate the development of advanced biomimetic artificial organelles.